Space Weather Technical Forecast

Issued on Tuesday, 10 May 2022 at 13:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1 on 10 and 11 May. Slight chance of R1 radio blackouts throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with only isolated low level C-class flares. There are currently two regions on the visible disc, with the most significant of these AR3006 (Dai/Beta-Delta) in the south central disc. Another region AR3007 (Dso/beta) further east shows some development in the intermediate spots. Several long filaments are also on the visible disc, and no Earth-directed CMEs have been observed in the last 24 hours. A large filament was observed to lift off the southwestern limb late in the period with a probable CME associated with it.

Solar Wind / Geomagnetic Activity: The solar wind as observed at L1, has been slow-ambient, around 300km/s, with density near average. Total interplanetary magnetic field strength remains weak, with the north-south component, Bz also varying weakly ranging from +5 to -5nT. Phi angle was mostly positive (away from the Sun) with a rotation to negative (towards the Sun observed around 10/0400UTC. Resultant geomagnetic activity has been Quiet (Kp0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels through the last 24 hours. High energy electron flux (greater than 2MeV) has been at background. Electron fluence is below the Active (1e8 integrated pfu) threshold with a mostly flat trend and a value of 1.24e6 integrated pfu observed at 10/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be mostly Low, with a slight chance of Moderate activity. This is mainly due to an evolving prominent region close to south-centre disc.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 06 May is due to impact the Earth in the next 18 to 24 hours. A coronal hole high speed stream may also connect with the Earth on 10 May. There is a chance (50%) of Active or G1 Minor Storm intervals on 10 and 11 May due to the probability of either feature affecting the Earth, or due to a mixture of the two. A return to Quiet or Unsettled geomagnetic conditions is anticipated from 12 May.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at background levels. The high energy electron flux (greater than 2MeV) is forecast to remain at normal background levels. The 24-hour electron fluence is expected to remain below the Active threshold throughout the forecast period.

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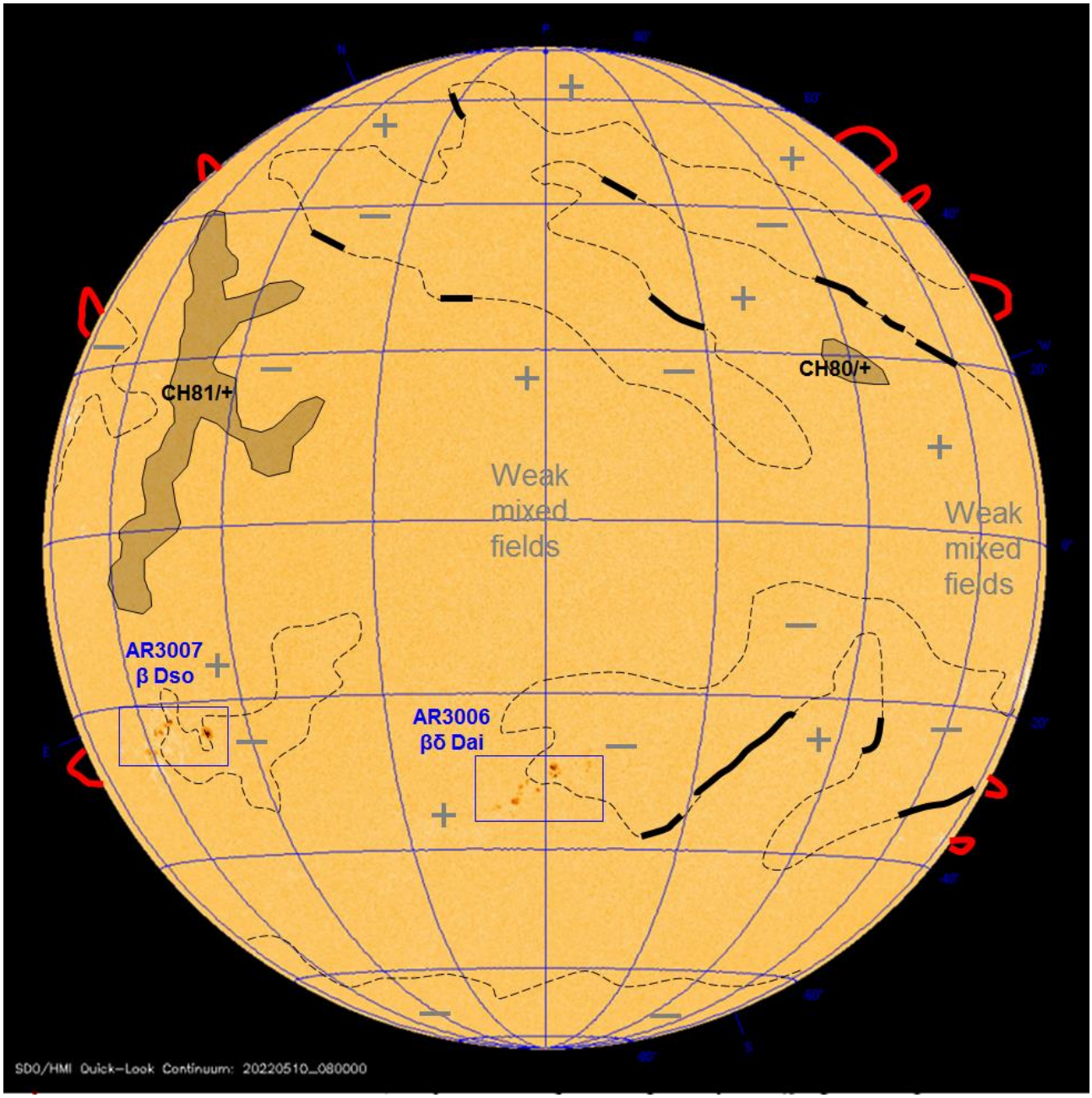
Figure 1. Solar Analysis Valid 0800UTC, 10 May 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

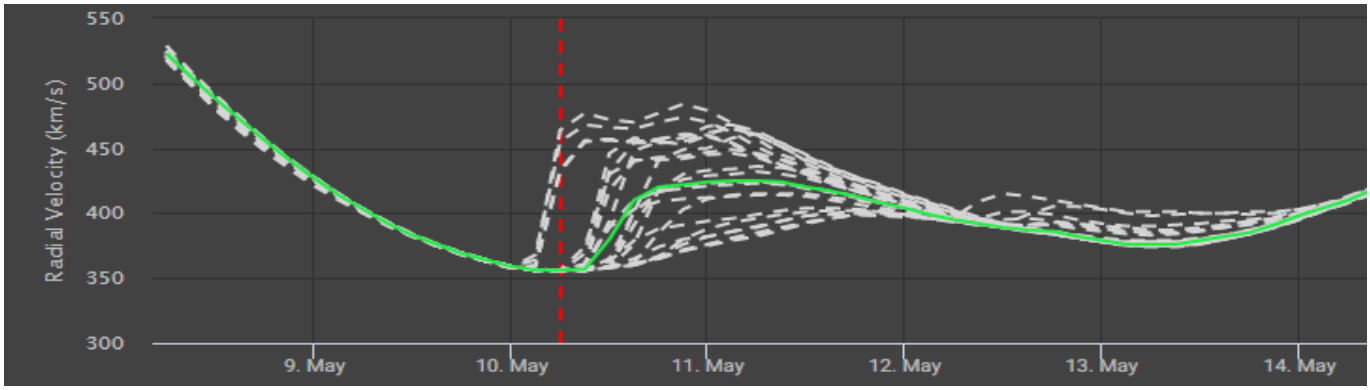
A CME which left the Sun on 06 May is due to arrive at Earth on 10 or 11 May, with Met Office Enlil model output suggesting that this could be a direct impact. The only caveat to this is that much of the ejecta from the originating filament eruption was to the southeast and southwest of the sun and there is some doubt about how much material is actually Earth directed.
The next coronal hole to affect the Earth is coronal hole 80 in the northern hemisphere, with the high speed stream from this feature likely to connect with the Earth on 10 May. This is quite a small feature and any impacts are likely to be minimal. There is a chance of a concurrent arrival of the CME and high speed stream.
Geomagnetic activity starting Quiet, with a chance of Active or G1/Minor Storm intervals on 10 and 11 May due to the onset of the CME and high speed stream, and slight chance (5%) of an isolated G2/Moderate storm interval. A return to Quiet to Unsettled conditions is then forecast from 12 May.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	50	10	1
Strong	G3	No	1	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/0800 UTC	Partial	Filament eruption	NE quadrant	581 km/s	After 0/1500UTC	Probably later that ENLIL forecast.

Figure 2: Met Office ENLIL Ensemble output, indicating spread of arrival times for the CME.



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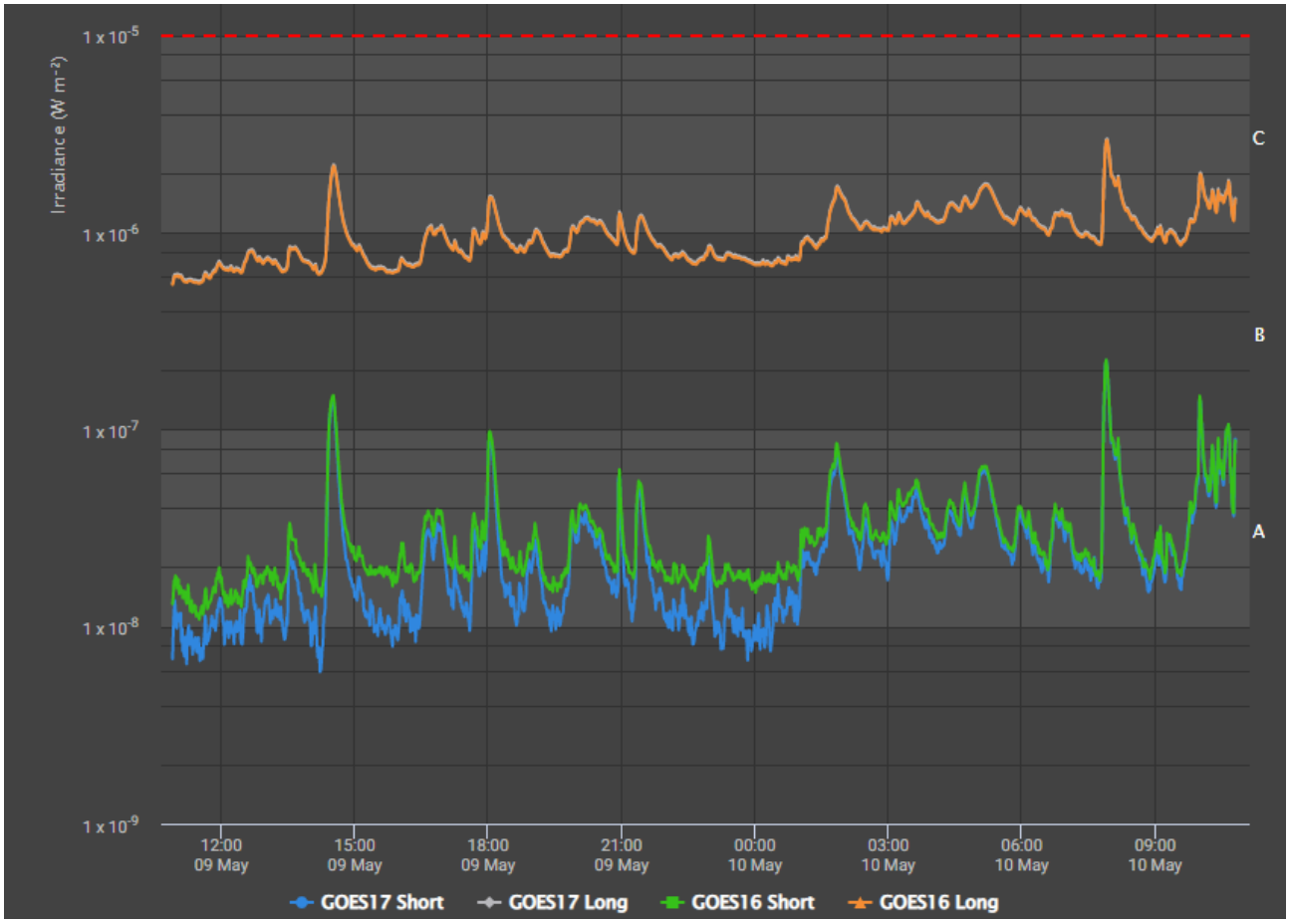
Radio Blackouts - X-Ray Flares:
The most distinct region is AR3006 in the south-centre disc. This region has a pronounced delta spot in the lead group but has not yet produced significant activity. Another region further east and close to the southeastern limb appears to be slightly less active is classified Dso/beta. Currently both of these regions probably don't pose a significant flare risk. Overall solar activity is likely to be Low, with a slight chance of Moderate activity, mainly from the active region currently near centre disc.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	15	15	20	20
Very Active	R3 to R5 X Class	No	1	1	3	5

Figure 3: X-ray flux at GEO showing isolated C-class flares in the past 24 hours.



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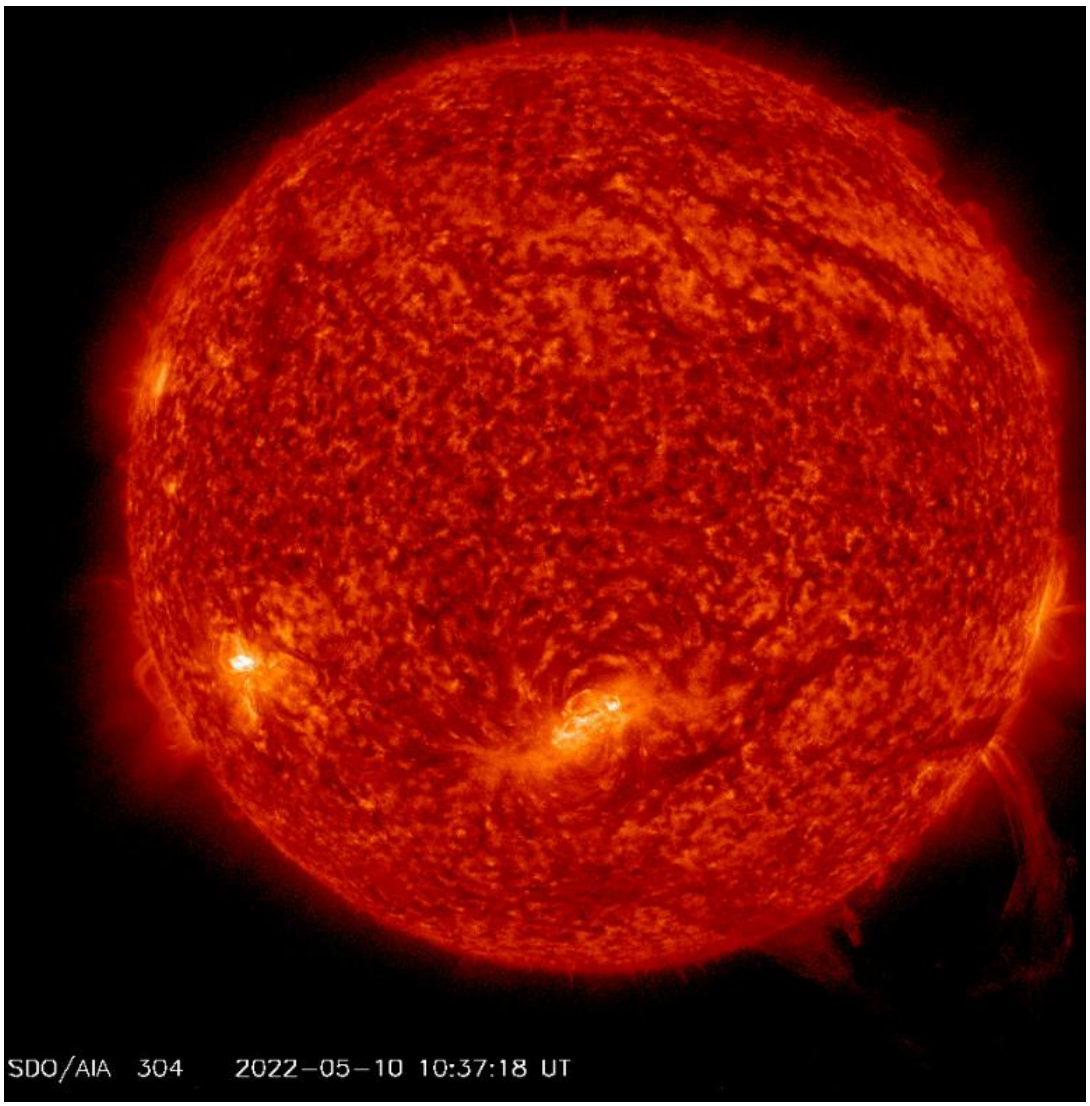
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background levels, and is most likely to remain so through the next four days.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO aia304 observatory image showing location of filaments and current active regions, as well as a filament lift off visible near the southwestern limb.



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux at GEO (greater than 2MeV) is expected to be at mainly background levels through the forecast period. This is due to an initial slow-ambient solar wind regime, followed by enhanced solar winds which could displace the belts from their orbits and geomagnetic activities which could suppress the count of electrons within the belts. Based on the analysis of potential electron flux, electron fluence is expected to be well below the Active (1e8 integrated pfu) threshold, and this is reflected in the table above with low probabilities throughout, as well as in output from the Met Office REFM.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy electron flux and Met Office REFM output since start of the month.

NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

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